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(54) **VEHICLE REMOTE PARK ASSIST WITH OCCUPANT DETECTION**

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(58) **Field of Classification Search**

None

See application file for complete search history.

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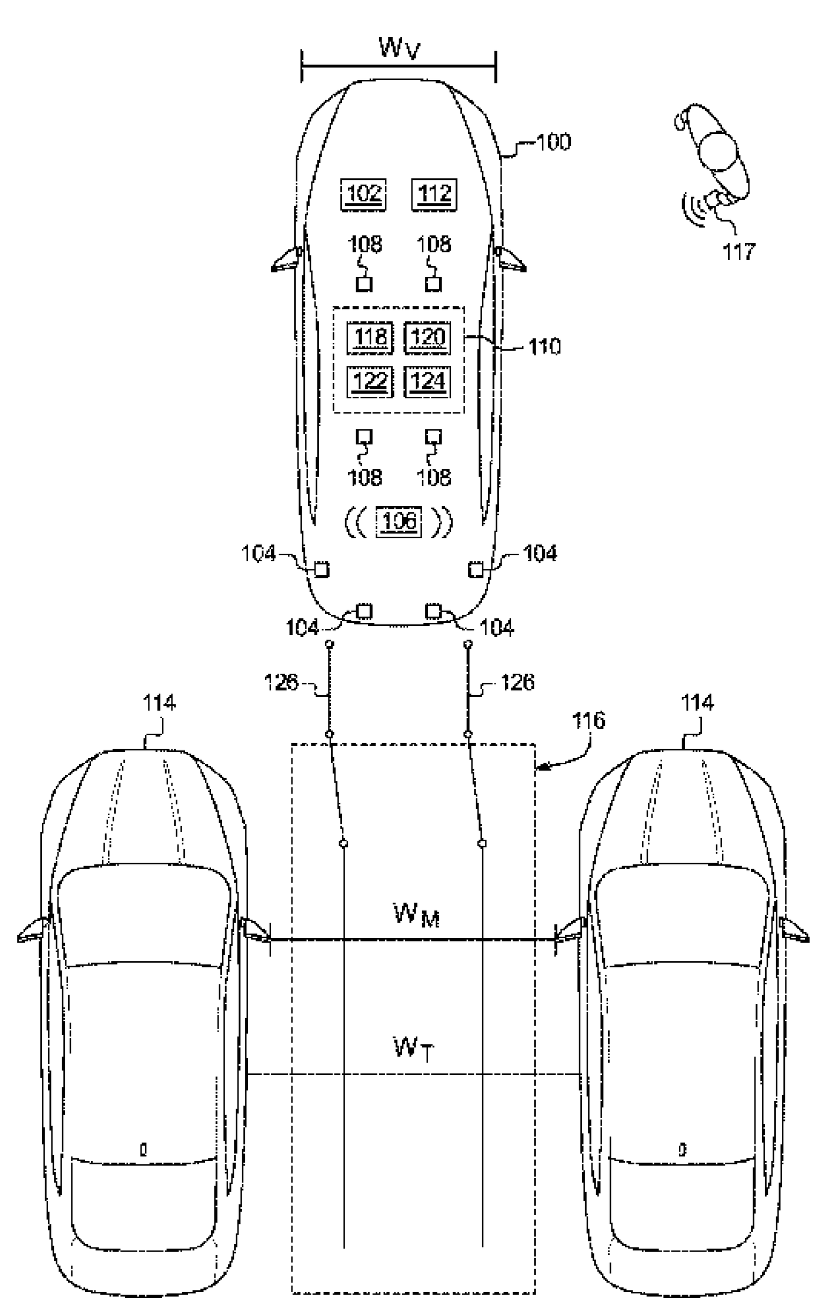
(57) **ABSTRACT**

Systems and methods are disclosed for vehicle remote park assist with occupant detection. An example disclosed vehicle includes range detection sensors and a remote parking unit. The example range detection sensors determine whether a target parking space is narrow. The example remote parking unit, in response to a request from a mobile device external to the vehicle, when the target parking space is narrow, scans, with occupant detection sensors, the interior of the vehicle. Additionally, the example remote parking unit, in response to detecting an occupant in the vehicle, sends a first notification to the mobile device.

21 Claims, 4 Drawing Sheets



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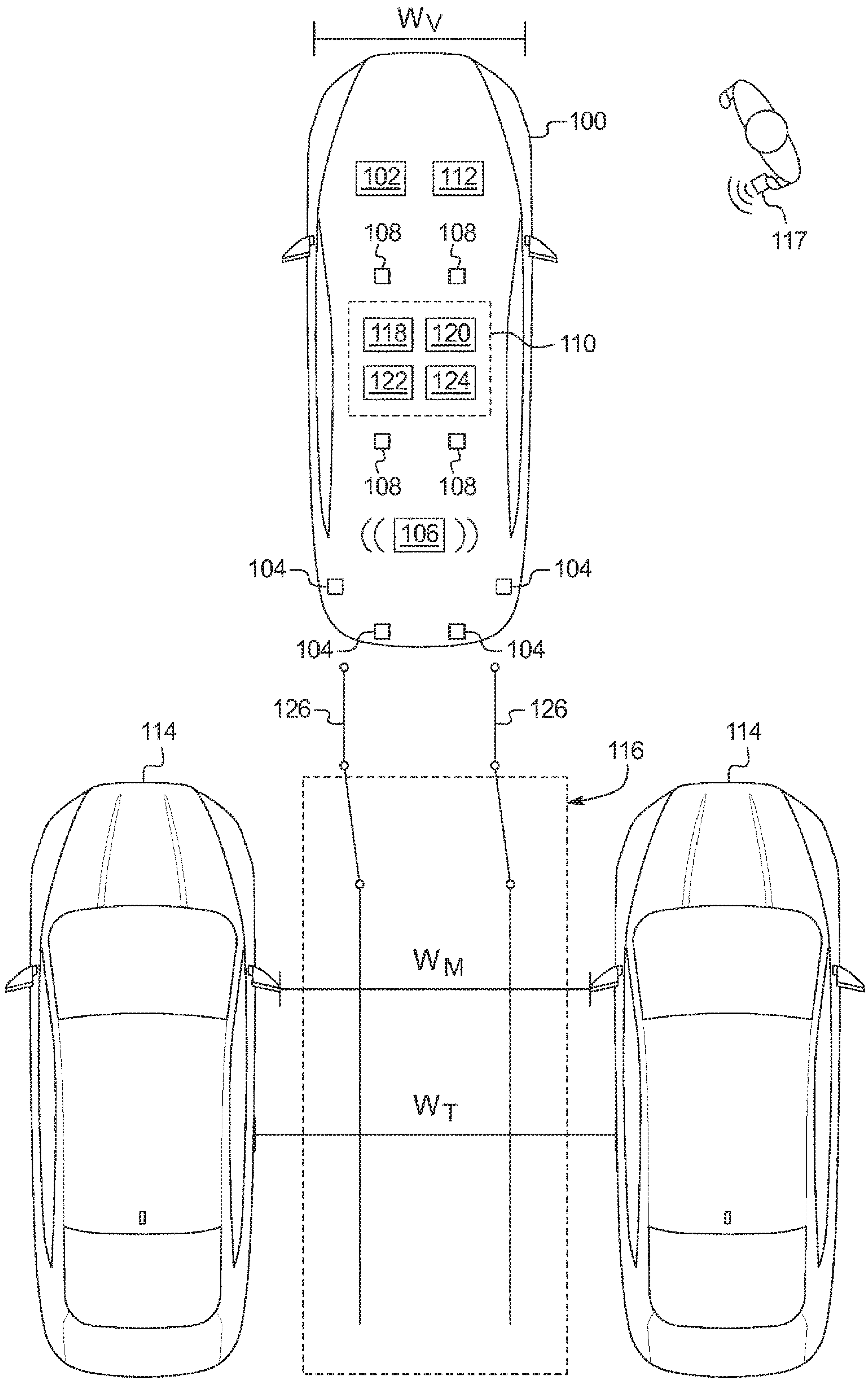


WV
100
102
112
108
108
117
118
120
122
124
110
108
108
106
104
104
104
104
126
126
114
116
114
WM
WT

FIG. 1

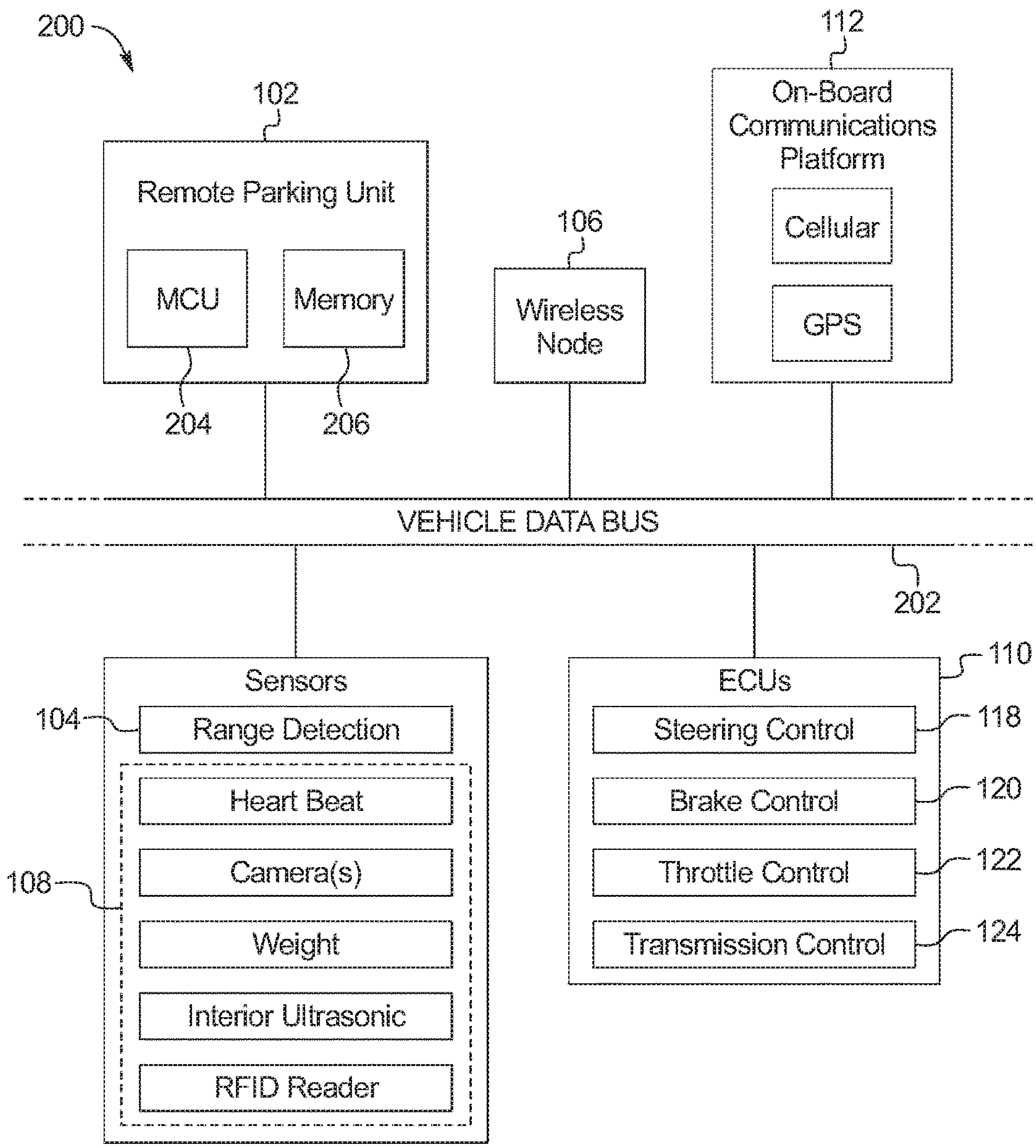
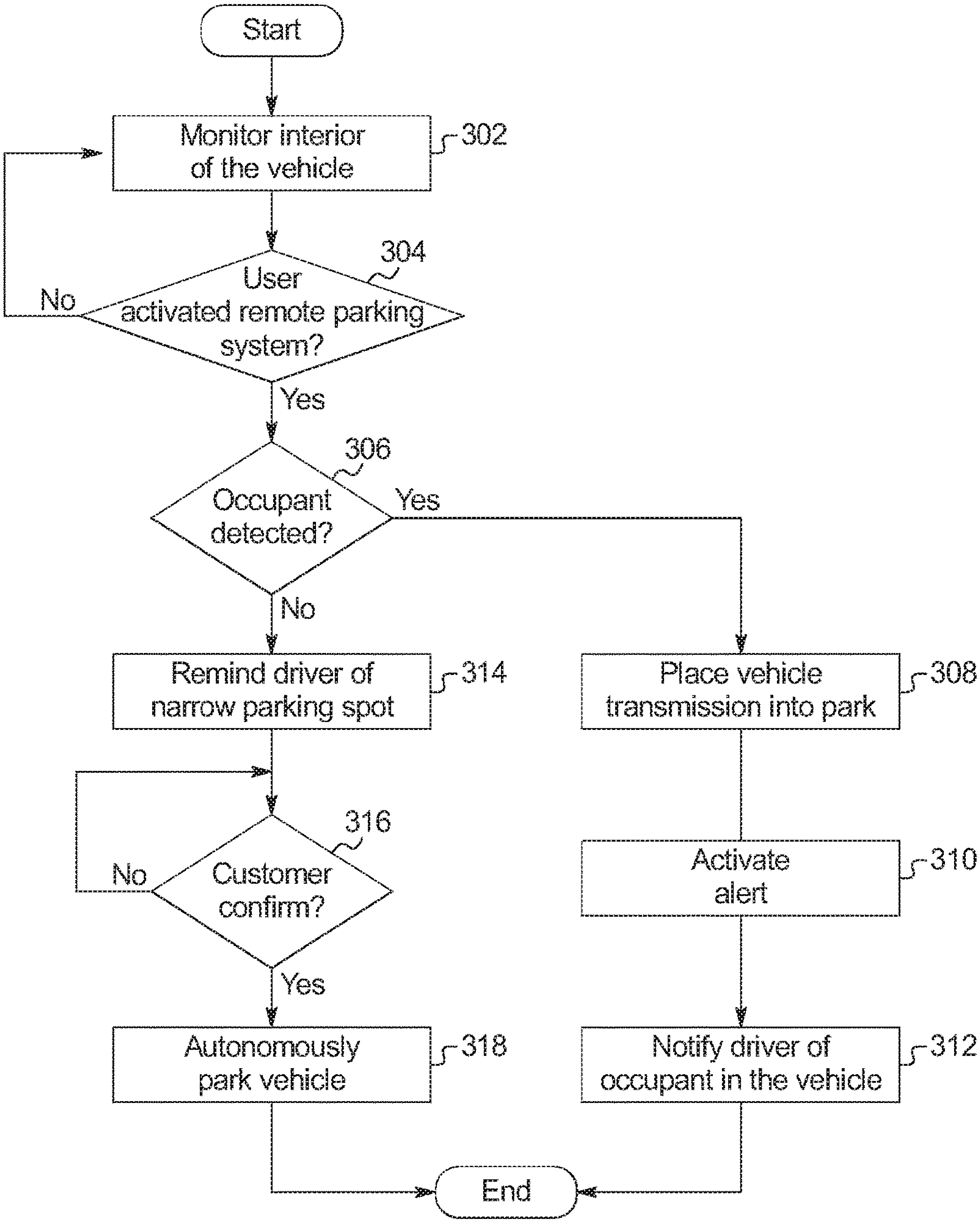

200
102
Remote Parking Unit
MCU
Memory
204
206
106
Wireless Node
112
On-Board Communications Platform
Cellular
GPS
VEHICLE DATA BUS
202
Sensors
104
Range Detection
108
Heart Beat
Camera(s)
Weight
Interior Ultrasonic
RFID Reader
110
ECUs
Steering Control
118
Brake Control
120
Throttle Control
122
Transmission Control
124

FIG. 2



Start
Monitor interior of the vehicle
302
User activated remote parking system?
304
No
Yes
Occupant detected?
306
Yes
No
Remind driver of narrow parking spot
314
Place vehicle transmission into park
308
Customer confirm?
316
No
Yes
Activate alert
310
Autonomously park vehicle
318
Notify driver of occupant in the vehicle
312
End

FIG. 3

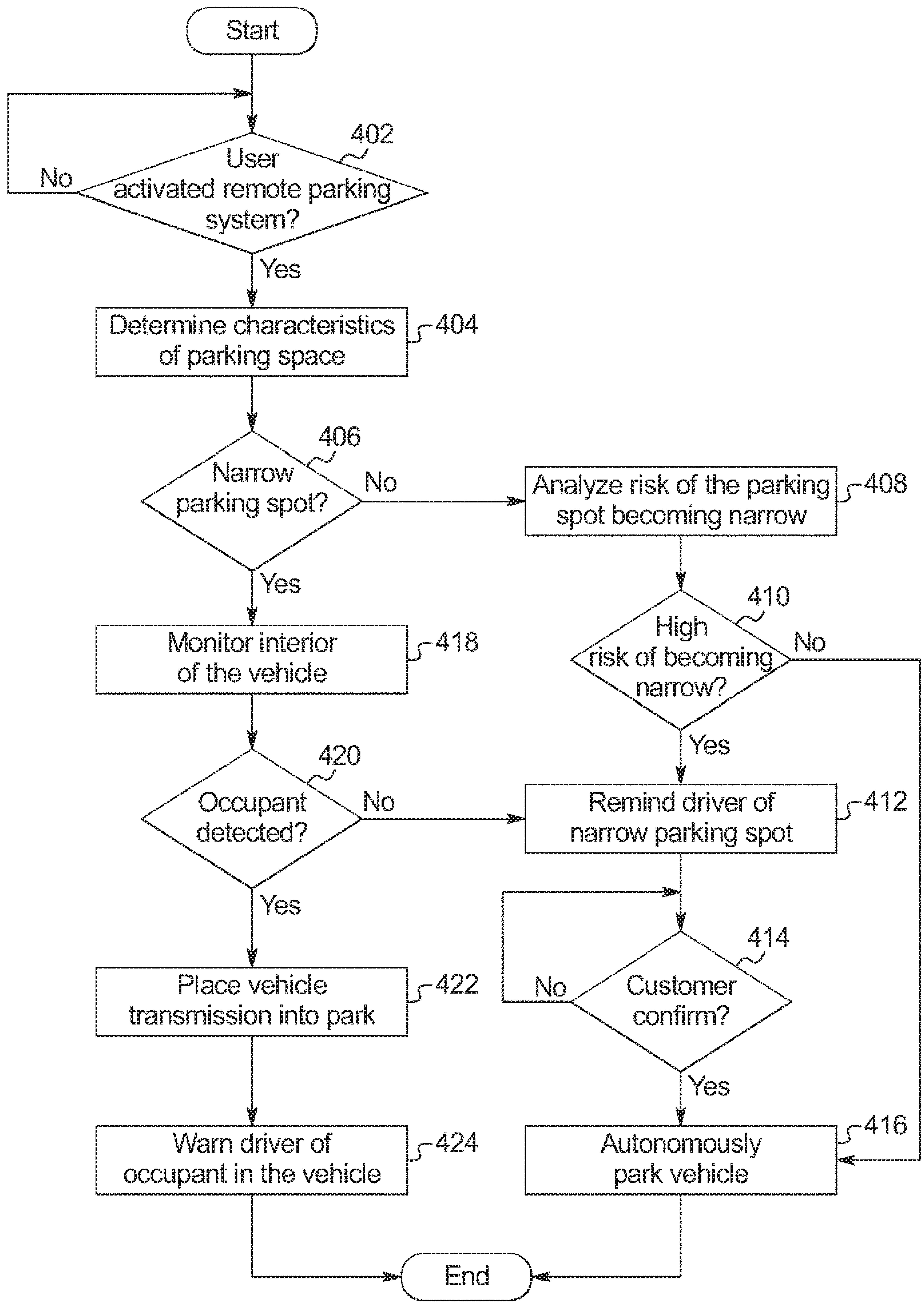

Start
402
User activated remote parking system?
No
Yes
Determine characteristics of parking space
404
406
Narrow parking spot?
No
Analyze risk of the parking spot becoming narrow
408
Yes
Monitor interior of the vehicle
418
410
High risk of becoming narrow?
No
Yes
420
Occupant detected?
No
Remind driver of narrow parking spot
412
Yes
Place vehicle transmission into park
422
414
Customer confirm?
No
Yes
Warn driver of occupant in the vehicle
424
Autonomously park vehicle
416
End

FIG. 4

VEHICLE REMOTE PARK ASSIST WITH OCCUPANT DETECTION

TECHNICAL FIELD

The present disclosure generally relates to semi-autonomous vehicles and, more specifically, vehicle remote park assist with occupant detection.

BACKGROUND

A semi-autonomous vehicle is a vehicle that is normally operated by a driver, but certain specialized functions are autonomous. For example, some vehicles have adaptive cruise control or autopilot that facilitates, in certain circumstances, the vehicle controlling its speed and following distance independent of driver controlling input. Increasingly, vehicles are equipped with parking assist functions that will park the vehicle. When activated remotely, parking assist systems facilitate parking vehicles in narrow spaces.

SUMMARY

The appended claims define this application. The present disclosure summarizes aspects of the embodiments and should not be used to limit the claims. Other implementations are contemplated in accordance with the techniques described herein, as will be apparent to one having ordinary skill in the art upon examination of the following drawings and detailed description, and these implementations are intended to be within the scope of this application.

Example embodiments are disclosed for vehicle remote park assist with occupant detection. An example disclosed vehicle includes range detection sensors and a remote parking unit. The example range detection sensors determine whether a target parking space is narrow. The example remote parking unit, in response to a request from a mobile device external to the vehicle, when the target parking space is narrow, scans, with occupant detection sensors, the interior of the vehicle. Additionally, the example remote parking unit, in response to detecting an occupant in the vehicle, sends a first notification to the mobile device.

An example disclosed method to remotely park a vehicle includes determining, with range detection sensors, whether a target parking space is narrow. The example method also includes, in response to a request from a mobile device external to the vehicle when the target parking space is narrow, scanning, with occupant detection sensors, the interior of the vehicle, and in response to detecting an occupant in the vehicle, sending, via a processor, a first notification to the mobile device.

An example disclosed tangible computer readable medium comprises instruction that, when executed, cause a vehicle to determine, with range detection sensors, whether a target parking space is narrow. Additionally, the example instructions, when executed, cause the vehicle to, in response to a request from a mobile device external to the vehicle, when the target parking space is narrow, scan, with occupant detection sensors, the interior of the vehicle, and in response to detecting an occupant in the vehicle, send a first notification to the mobile device.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, reference may be made to embodiments shown in the following drawings. The components in the drawings are not necessarily to scale and related elements may be omitted, or in some instances proportions may have been exaggerated, so as to emphasize and clearly illustrate the novel features described herein. In addition, system components can be variously arranged, as known in the art. Further, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** illustrates a vehicle operating in accordance with the teachings of this disclosure.

FIG. **2** is a block diagram of electronic components of the vehicle of FIG. **1**.

FIG. **3** is a flow diagram of a method to perform remote assisted parking that may be implemented by the electronic components of FIG. **2**.

FIG. **4** is a flow diagram of another method to perform remote assisted parking that may be implemented by the electronic components of FIG. **2**.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

While the invention may be embodied in various forms, there are shown in the drawings, and will hereinafter be described, some exemplary and non-limiting embodiments, with the understanding that the present disclosure is to be considered an exemplification of the invention and is not intended to limit the invention to the specific embodiments illustrated.

Remote park assist systems facilitate a customer exiting the vehicle before the remote park assist system autonomously parks the vehicle. The driver activates the remote park assist system using a button on a key and/or an interface on an authorized mobile device (e.g., a smart phone, a smart watch, a tablet, etc.). In such a manner, a vehicle may be parked in a narrow space in which the doors of the vehicle cannot be opened. This facilitates parking vehicles more densely in a space saving manner. However, if the vehicle is parked while an occupant or an object of interest (e.g., a purse, a wallet, a mobile device, etc.) is in the vehicle, traditionally, the remote park assist system needs reverse to a point where the door can be opened.

As disclosed herein below, a vehicle includes a remote parking unit to autonomously park the vehicle. The remote parking unit is communicatively coupled, via one or more vehicle data buses, to other electronic control units (ECUs) that control the motive functions of the vehicle. For example, the ECUs may include a transmission control unit, a throttle control unit, and a brake control, etc. The remote parking unit is also communicatively coupled to range detection sensors to detect objects in the proximity of the vehicle and the location, size and shape of the parking spot. Additionally, the remote parking unit includes an occupant detector. As used herein, an occupant is defined to include (i) humans and animals, and (ii) objects configured to be detected (e.g., a purse, a wallet, a mobile device, a stroller, a child seat, etc.). The occupant detector monitors the interior of the vehicle for occupants. When the remote parking unit is activated, the occupant detector determines whether an occupant is inside the vehicle. If an occupant is not detected, the occupant detector sends a message to the key fob or the mobile device to remind the driver the vehicle is about to be parked into a narrow space. If an occupant is detected, the remote parking unit (a) instructs the transmission control unit to shift the transmission into park, and (b) sends a message to the key fob or the mobile device to notify the driver that the occupant is in the vehicle. In some examples, the occupant detector, based on data from the range detection and navigation data, determines whether the parking space is currently narrow or projected become a narrow parking space in the future. As used herein a narrow parking space is a parking space in which the vehicle, with its doors closed, is able to fit, but the doors cannot be open to facilitate the entrance or exit of the driver or an occupant. For example, if the parking lot in which the vehicle is being parked is designed to have narrow parking spots, the occupant detector may act as if the parking spot is a narrow parking spot even if one or more of the adjacent parking spaces are currently empty.

FIG. **1** illustrates an assisted vehicle **100** operating in accordance with the teachings of this disclosure. As used herein, an assisted vehicle **100** is a vehicle that includes a remote parking unit **102** that controls the motive functions of the vehicle to park the vehicle without a driver occupying the vehicle. The assisted vehicle **100** may be a standard gasoline powered vehicle, a hybrid vehicle, an electric vehicle, a fuel cell vehicle, and/or any other mobility implement type of vehicle. The assisted vehicle **100** includes parts related to mobility, such as a powertrain with an engine, a transmission, a suspension, a driveshaft, and/or wheels, etc. Additionally, the assisted vehicle **100** may be semi-autonomous or autonomous. A semi-autonomous vehicle is a vehicle that autonomously controls some routine motive functions (e.g., assisted parking, remote assisted parking, adaptive cruise control, etc.) while the driver controls the vehicle. An autonomous vehicle is a vehicle that autonomously controls the motive functions of the vehicle without direct user steering input. In the illustrated example, the assisted vehicle **100** includes range detection sensors **104**, a wireless network node **106**, occupant detection sensors **108**, electronic control units (ECUs) **110**, and the remote parking unit **102**. In some examples, the assisted vehicle **100** includes an on-board communications platform **112**.

The range detection sensors **104** sense objects, such as parked vehicle **114**, and characterize spaces, such a parking space **116**, in the vicinity of the assisted vehicle **100**. The range detection sensors **104** include ultrasonic sensors, cameras, infrared sensors, RADAR, and/or LiDAR, etc. In the illustrated example, the range detection sensors **104** are embedded in the bumper of the assisted vehicle **100** to detect the parked vehicles **114** and characterized the parking space **116** for the remote parking unit **102**. Alternatively, the range detection sensors **104** may be positioned in other locations (e.g., on the roof of the assisted vehicle **100**, etc.) to facilitate detecting the parked vehicles **114** and characterized the parking space **116**. In the illustrated example, the range detection sensors **104** determine a mirror width (W_M) (e.g., the width between the side view mirrors of the parked vehicles **114**) and a total width (W_T) (e.g. the width between the parked vehicles **114** at the point that a vehicle parked between them would open its doors).

The wireless network node **106** connects to a mobile device **117** (e.g., a smart phone, a smart watch, a tablet computer, etc.) of the driver of the assisted vehicle **100**. In some examples, the wireless network node **106** is configured in accordance with Bluetooth Low Energy (BLE) as specified in the Bluetooth Specification 4.0 (as revised) maintained by the Bluetooth Special Interest Group. Alternatively, in some examples, the wireless network node **106** may operate in accordance with other local area or personal area network standards, such as Bluetooth, IEEE 802.11 or IEEE 802.15.4. When connected to the mobile device **117**, the wireless network node **106** facilitates input by a user to the remote parking unit **102** (e.g., activating the remote parking system, etc.). Additionally, the remote parking unit **102** may send notifications to the mobile device **117** via the wireless network node **106**.

The occupant detection sensors **108** detect occupants inside the assisted vehicle **100**. In some examples, the occupant detection sensors **108** detect indicators of the presences of the occupants (e.g., biometric sensors, weight sensors, interior ultrasonic sensors, cameras, heartbeat sensors, etc.). Additionally, in some examples, the occupant detection sensors **108** detect tags associated with the occupants (e.g., radio-frequency identification (RFID) readers, BLE nodes, etc.). The tags are active or passive devices configured to attach to objects (e.g., purses, wallets, car seats, baby carriers, etc.) that respond when interrogated by the corresponding occupant detection sensor **108**. For example, the tag may be a passive RFID circuit that responds when interrogated by an RFID reader. The occupant detection sensors **108**, from time to time (e.g., periodically, aperiodically, etc.) activate their various functions (sometimes referred to as "scanning") to detect occupants inside the cabin of the assisted vehicle **100**.

The ECUs **110** monitor and control subsystems of the assisted vehicle **100**. The ECUs **110** communicate and exchange information via the a vehicle data bus (e.g., the vehicle data bus **202** of FIG. **2** below). Additionally, the ECU(s) **110** may communicate properties (such as, status of the ECU **110**, sensor readings, control state, error and diagnostic codes, etc.) to and receive instructions from other devices (e.g., the remote parking unit **102**, etc.) Some assisted vehicles **100** may have seventy or more ECUs **110** located in various locations around the assisted vehicle **100** communicatively coupled by the vehicle data bus. The ECUs **110** are discrete sets of electronics that include their own circuit(s) (such as integrated circuits, microprocessors, memory, storage, etc.) and firmware, sensors, actuators, and/or mounting hardware. In the illustrated example, the ECUs **110** include a steering control unit **118**, a brake control unit **120**, a throttle control unit **122**, and a transmission control unit **124**. The steering control unit **118** includes actuators to control the steering (e.g., the angle of the wheels) of the assisted vehicle **100** without driver input. The brake control unit **120** includes actuators to operate the brakes of the assisted vehicle **100** without driver input. Additionally, the throttle control unit **122** controls is capable of adjust the throttle position of the assisted vehicle **100** without driver input. The transmission control unit **124** facilitates changed the transmission setting of the assisted vehicle **100** without driver input.

The on-board communications platform **112** includes wired or wireless network interfaces to enable communication with external networks. The on-board communications platform **112** also includes hardware (e.g., processors, memory, storage, antenna, etc.) and software to control the wired or wireless network interfaces. The on-board communications platform **112** may include controllers for Bluetooth® and/or other standards-based networks (e.g., Global System for Mobile Communications (GSM), Universal Mobile Telecommunications System (UMTS), Long Term Evolution (LTE), Code Division Multiple Access (CDMA), WiMAX (IEEE 802.16m); Near Field Communication (NFC); local area wireless network (including IEEE 802.11 a/b/g/n/ac or others), and Wireless Gigabit (IEEE 802.11ad), etc.). The on-board communications platform **112** may also include a global positioning system (GPS) receiver. Further, the external network(s) may be a public network, such as the Internet; a private network, such as an intranet; or combinations thereof, and may utilize a variety of networking protocols now available or later developed including, but not limited to, TCP/IP-based networking protocols.

The remote parking unit **102** parts the assisted vehicle **100** into the parking space **116** in response to a request from a user (e.g., via the mobile device **117** communicatively coupled to the wireless network node **106**). The remote parking unit **102** facilitates parking the assisted vehicle **100** into a narrow parking space (e.g., the parking space **116**) without the driver in the assisted vehicle **100**. For example, the driver may park the assisted vehicle **100** near the target parking space **116**, exit the assisted vehicle **100**, and engage the remote parking assist system. In such an example, the remote parking unit **102** may maneuver the assisted vehicle **100** into the parking space **116** by controlling the ECUs **110**. Additionally, the remote parking unit **102** facilitates the assisted vehicle **100** exiting the parking space **116** without the driver in the assisted vehicle **100**.

The remote parking unit **102**, via the range detection sensors **104**, locates the parked vehicle(s) **112** and characterizes the spatial dimensions of the parking space **116**. Based on the mirror width (W_M), the total width (W_T) and a vehicle width (W_V) of the assisted vehicle **100**, the remote parking unit **102** determines whether the assisted vehicle **100** will fit into the parking space **116**. If the assisted vehicle **100** will fit into the parking space **116**, the remote parking unit **102** calculates a path **126** to maneuver the assisted vehicle **100** into the parking space **116**. If the assisted vehicle **100** will fit into the parking space **116**, the remote parking unit **102** notifies the driver (e.g., via the mobile device **117**).

Additionally, the remote parking unit **102**, via the occupant detection sensors **108**, monitors the cabin of the assisted vehicle **100** to determine whether occupants are inside the assisted vehicle **100**. In some examples, the occupant detection sensors **108** detect indicia of the occupant(s), such as a heartbeat, weight on one of the seats, camera object recognition, movement, etc. In some examples, the occupant detection sensors **108** detect the tags affixed to objects in the cabin. If an occupant is detected when the driver activates the remote parking system, the remote parking unit **102**, via the transmission control unit **124**, shifts the transmission of the assisted vehicle **100** into park and sends a notification, via the wireless network node **106**, to the driver that an occupant was detected in the assisted vehicle **100**.

In some examples, the remote parking unit **102** determines whether the parking space **116** will become a narrow parking space. For example, if only one parked vehicle **114** is currently adjacent to the parking space **116**, the parking space **116** may become a narrow parking space when another parked vehicle **114** parks adjacent to the parking space **116**. In some such examples, the remote parking unit **102** connects, via the on-board communications platform **112**, to a server on an external network (e.g., the Internet) to determine whether the parking space **116** is a known narrow parking space. For example, a navigation data provider (e.g., Google®, MapQuest®, Waze®, etc.) may supply data on whether the current location of the assisted vehicle **100** (e.g., supplied by the GPS receiver of the on-board communications platform **112**) is a location with narrow parking spaces. Additionally or alternatively, in some examples, the remote parking unit **102** analyzes other vehicle park in the vicinity and/or analyzes (e.g., when the range detection sensors **104** include external cameras) width of the marking delineating the parking space **116**. In some such examples, if the parking space **116** may become a narrow parking space, the remote parking unit **102** acts as if it is currently a narrow parking space.

FIG. **2** is a block diagram of electronic components **200** of the assisted vehicle **100** of FIG. **1**. In the illustrated example, the electronic components **200** include the remote parking unit **102**, the on-board communications platform **112**, the sensors **104** and **108**, the wireless network node **106**, the ECUs **110**, and a vehicle data bus **202**.

The remote parking unit **102** includes a processor or controller **204**, and memory **206**. The processor or controller **204** may be any suitable processing device or set of processing devices such as, but not limited to: a microprocessor, a microcontroller-based platform, a suitable integrated circuit, one or more field programmable gate arrays (FPGAs), and/or one or more application-specific integrated circuits (ASICs). The memory **206** may be volatile memory (e.g., RAM, which can include non-volatile RAM, magnetic RAM, ferroelectric RAM, and any other suitable forms); non-volatile memory (e.g., disk memory, FLASH memory, EPROMs, EEPROMs, memristor-based non-volatile solid-state memory, etc.), unalterable memory (e.g., EPROMs), read-only memory, and/or high-capacity storage devices (e.g., hard drives, solid state drives, etc). In some examples, the memory **206** includes multiple kinds of memory, particularly volatile memory and non-volatile memory.

The memory **206** is computer readable media on which one or more sets of instructions, such as the software for operating the methods of the present disclosure can be embedded. The instructions may embody one or more of the methods or logic as described herein. In a particular embodiment, the instructions may reside completely, or at least partially, within any one or more of the memory **206**, the computer readable medium, and/or within the processor **204** during execution of the instructions.

The terms "non-transitory computer-readable medium" and "computer-readable medium" should be understood to include a single medium or multiple media, such as a centralized or distributed database, and/or associated caches and servers that store one or more sets of instructions. The terms "non-transitory computer-readable medium" and "computer-readable medium" also include any tangible medium that is capable of storing, encoding or carrying a set of instructions for execution by a processor or that cause a system to perform any one or more of the methods or operations disclosed herein. As used herein, the term "computer readable medium" is expressly defined to include any type of computer readable storage device and/or storage disk and to exclude propagating signals.

The vehicle data bus **202** communicatively couples the remote parking unit **102**, the on-board communications platform **112**, the sensors **104** and **108**, the wireless network node **106**, and the ECUs **110**. In some examples, the vehicle data bus **202** includes one or more data buses. The vehicle data bus **202** may be implemented in accordance with a controller area network (CAN) bus protocol as defined by International Standards Organization (ISO) 11898-1, a Media Oriented Systems Transport (MOST) bus protocol, a CAN flexible data (CAN-FD) bus protocol (ISO 11898-7), a K-line bus protocol (ISO 9141 and ISO 14230-1), and/or an Ethernet™ bus protocol IEEE 802.3 (2002 onwards), etc. In some examples, the ECUs **110** and sensors **104** and **108** are organized on separate data buses to manage, for example, safety, data congestion, data management, etc. For example, the sensitive ECUs **110** (e.g., the brake control unit **120**, the throttle control unit **122**, etc.) may be on a separate bus from the other ECUs **110** and sensors **104** and **108**.

FIG. **3** is a flow diagram of a method to perform remote assisted parking that may be implemented by the electronic components **200** of FIG. **2**. Initially, at block **302**, the remote parking unit **102** monitors the interior of the assisted vehicle **100** for occupants. At block **304**, the remote parking unit **102** waits until the driver activates the remote parking system. In response to the driver activating the remote parking system, at block **306**, the remote parking unit **102** determines whether the occupant detection sensors **108** detect an occupant in the interior of the assisted vehicle **100**. For example, the occupant detection sensors **108** may detect a tag affixed to a purse in the cabin of the assisted vehicle **100**. If the occupant detection sensors **108** detect an occupant in the interior of the assisted vehicle **100**, the method continues at block **308**. Otherwise, if the occupant detection sensors **108** do not detect an occupant in the interior of the assisted vehicle **100**, the method continues at block **314**.

At block **308**, the remote parking unit **102** instructs the transmission control unit **124** to shift the transmission of the assisted vehicle **100** into park. At block **310**, the remote parking unit **102** instructs the assisted vehicle **100** (e.g., via a body control unit) to alert the driver (e.g., activate hazard lights, activate a horn with a short burst pattern, flash lights of the vehicle, etc.). At block **312**, the remote parking unit **102**, via the wireless network node **106**, sends a notification to the mobile device **117** of the driver to inform them of the detected occupant. In some examples, the notification causes the mobile device **117** to display a text or picture warning, vibrate, and/or produce an audio warning, etc. In some examples, if an identifier is associated with the occupant (e.g., an identifier of an RFID tag associated with the occupant), the notification includes the identifier.

At block **314**, the remote parking unit **102**, via the wireless network node **106**, sends a notification to the mobile device **117** of the driver to (i) remind the driver that the of the narrow parking spot and (ii) prompt a confirmation process on the mobile device **117**. For example, the notification may cause the mobile device **117** to display, "Warning: there is not enough room to open vehicle doors when parked in this space." At block **316**, the remote parking unit **102** waits until a confirmation is received from the mobile device **117** of the driver. At block **318**, the remote parking unit **102** parks the assisted vehicle **100** in the parking space **116**.

FIG. **4** is a flow diagram of another method to perform remote assisted parking that may be implemented by the electronic components **200** of FIG. **2**. Initially, at block **402**, the remote parking unit **102** waits until the driver activates the remote parking system. At block **404**, the remote parking unit **102** determines, via the range detection sensors **104**, the dimensions of the parking space **116**. For example, the remote parking unit **102** determines the mirror width (W_M) and the total width (W_T) of the parking space **116**. At block **406**, the remote parking unit **102** determines whether the parking space **116** is a narrow parking space. If the parking space **116** is not a narrow parking space, the method continues at block **408**. Otherwise, if the parking space **116** is a narrow parking space, the method continues at block **418**.

At block **408**, the remote parking unit **102** analyzes whether the parking space **116** will become a narrow parking space. In some examples, the remote parking unit **102** connects, via the on-board communications platform **112**, to a server on an external network (e.g., via an application programming interface (API)) to request navigation data indicating whether the parking area in the vicinity of the assisted vehicle **100** is designated as having narrow parking spaces. Alternatively or additionally, in some examples, the remote parking unit **102** analyzes markings in the parking space **116** delineating the boundaries of the parking space

116. At block **410**, the remote parking unit **102** determines whether the parking space **116** may become a narrow parking space. If the parking space **116** may become a narrow parking space, the method continues to block **412**. Otherwise, if the parking space **116** will not become a narrow parking space, the method continues to block **416**.

At block **412**, the remote parking unit **102**, via the wireless network node **106**, sends a notification to the mobile device **117** of the driver to (i) remind the driver that the of the narrow parking spot and (ii) prompt a confirmation process on the mobile device **117**. At block **414**, the remote parking unit **102** waits until a confirmation is received from the mobile device **117** of the driver. At block **316**, the remote parking unit **102** parks the assisted vehicle **100** in the parking space **116**.

At block **418**, the remote parking unit **102** scans the interior of the assisted vehicle **100** for occupants. At block **420**, the remote parking unit **102** determines whether the occupant detection sensors **108** detect an occupant in the interior of the assisted vehicle **100**. For example, the occupant detection sensors **108** may detect a heartbeat with a heartbeat sensor and weight from a weight sensor monitoring the back seat. If the occupant detection sensors **108** detect an occupant in the interior of the assisted vehicle **100**, the method continues at block **422**. Otherwise, if the occupant detection sensors **108** do not detect an occupant in the interior of the assisted vehicle **100**, the method continues at block **412**.

At block **422**, the remote parking unit **102** instructs the transmission control unit **124** to shift the transmission of the assisted vehicle **100** into park. At block **424**, the remote parking unit **102**, via the wireless network node **106**, sends a notification to the mobile device **117** of the driver to inform them of the detected occupant. In some examples, if an identifier is associated with the occupant (e.g., an identifier of an RFID tag associated with the occupant), the notification includes the identifier.

The flowchart of FIGS. **3** and **4** are a methods that may be implemented by machine readable instructions that comprise one or more programs that, when executed by a processor (such as the processor **204** of FIG. **2**), cause the assisted vehicle **100** to implement the remote parking unit **102** of FIG. **1**. Further, although the example program(s) is/are described with reference to the flowcharts illustrated in FIGS. **3** and **4**, many other methods of implementing the example the remote parking unit **102** may alternatively be used. For example, the order of execution of the blocks may be changed, and/or some of the blocks described may be changed, eliminated, or combined.

In this application, the use of the disjunctive is intended to include the conjunctive. The use of definite or indefinite articles is not intended to indicate cardinality. In particular, a reference to "the" object or "a" and "an" object is intended to denote also one of a possible plurality of such objects. Further, the conjunction "or" may be used to convey features that are simultaneously present instead of mutually exclusive alternatives. In other words, the conjunction "or" should be understood to include "and/or". The terms "includes," "including," and "include" are inclusive and have the same scope as "comprises," "comprising," and "comprise" respectively.

The above-described embodiments, and particularly any "preferred" embodiments, are possible examples of implementations and merely set forth for a clear understanding of the principles of the invention. Many variations and modifications may be made to the above-described embodiment(s) without substantially departing from the spirit and principles of the techniques described herein. All modifications are intended to be included herein within the scope of this disclosure and protected by the following claims.

What is claimed is:

1. A vehicle comprising:
range detection sensors to determine whether a target parking space is narrow; and
a remote parking unit to:
responsive to a request from a mobile device external to the vehicle:
when the target parking space is narrow:
scan, with occupant detection sensors, an interior of the vehicle; and
responsive to detecting no occupants in the vehicle, send, to the mobile device, a first notification indicating that the target parking space is narrow.

2. The vehicle of claim **1**, wherein the range detection sensors include at least one of a plurality of ultrasonic sensors, a RADAR, a LiDAR, an infrared sensors, or a camera.

3. The vehicle of claim **1**, wherein the occupant detection sensors include at least one of an ultrasonic sensor, a weight sensor, a camera, a heartbeat sensor, or an RFID reader.

4. The vehicle of claim **1**, wherein the target parking space is narrow when a width of the target parking space is less than a width of the vehicle with doors of the vehicle open to facilitate entering and exiting the vehicle.

5. The vehicle of claim **1**, wherein when the target parking space is not narrow, the remote parking unit is to determine a likelihood that the target parking space will become narrow.

6. The vehicle of claim **5**, wherein the remote parking unit is to, when the target parking space is likely to become narrow, scan, the with occupant detection sensors, the interior of the vehicle.

7. The vehicle of claim **5**, wherein the remote parking unit is to determine the likelihood at least in part by receiving navigation data from an external server, the navigation data indicating one or more locations with a narrow parking space.

8. The vehicle of claim **5**, wherein the remote parking unit is to determine the likelihood at least in part by scanning, via the range detection sensors:
one or more parking spaces that are similar to the target parking space; and
one or more objects surrounding the one or more parking spaces.

9. The vehicle of claim **1**, wherein the remote parking unit is to, in response to detecting an occupant in the vehicle, activate a warning produced by the vehicle.

10. The vehicle of claim **9**, wherein the warning includes at least one of activating a horn in a short burst pattern, flashing lights of the vehicle, or activating hazard light of the vehicle.

11. The vehicle of claim **1**, wherein the remote parking unit is to, when the target parking space is narrow, send a second notification to the mobile device.

12. A method to remotely park a vehicle comprising:
determining, with range detection sensors, whether a target parking space is narrow;
in response to a request from a mobile device external to the vehicle:
when the target parking space is narrow:
scanning, with occupant detection sensors, an interior of the vehicle; and
in response to detecting no occupants in the vehicle, sending, via a processor, to the mobile device, a first notification indicating that the target parking space is narrow.

13. The method of claim **12**, wherein the range detection sensors include at least one of a plurality of ultrasonic sensors, a RADAR, a LiDAR, an infrared sensors, or a camera.

14. The method of claim **12**, wherein the occupant detection sensors include at least one of an ultrasonic sensor, a weight sensor, a camera, a heartbeat sensor, or an RFID reader.

15. The method of claim **12**, wherein the target parking space is narrow when a width of the target parking space is less than a width of the vehicle with doors of the vehicle open to facilitate entering and exiting the vehicle.

16. The method of claim **12**, including, when the target parking space is not narrow, determining a likelihood that the target parking space will become narrow.

17. The method of claim **16**, including, when the target parking space is likely to become narrow, scanning, the with occupant detection sensors, the interior of the vehicle.

18. The method of claim **12**, including, in response to detecting an occupant in the vehicle, activating a warning produced by the vehicle.

19. The method of claim **18**, wherein activating the warning includes at least one of activating a horn in a short burst pattern, flashing lights of the vehicle, or activating hazard light of the vehicle.

20. The method of claim **12**, including, when the target parking space is narrow, sending a second notification to the mobile device.

21. A tangible, non-transitory, computer-readable medium comprising instruction that, when executed, cause a vehicle to:
determine, with range detection sensors, whether a target parking space is narrow;
in response to a request from a mobile device external to the vehicle:
when the target parking space is narrow;
scan, with occupant detection sensors, an interior of the vehicle; and
in response to detecting no occupants in the vehicle, send, to the mobile device, a first notification indicating that the target parking space is narrow.

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